THE HOME OF THE BEES.

BY A. S. PACKARD, JR., M. D.

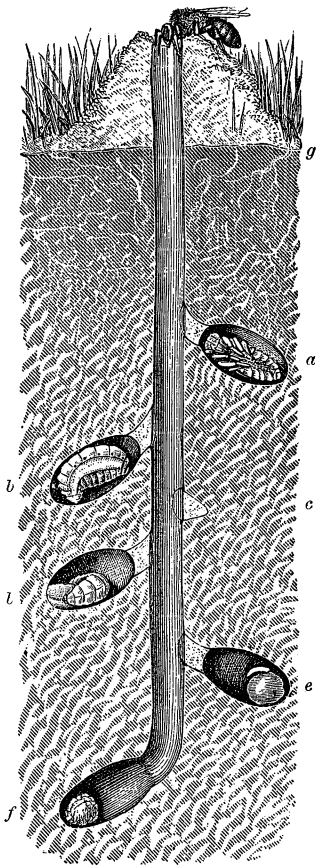
(Concluded from page 378.)

WHILE the Andrena and Halictus bees, whose habits we now describe, are closely allied in form to the Hive-bee, socially they are the "mud-sills" of bee society, ranking among the lowest forms of the family of bees, or *Apidæ*. Their burrowing habits ally them with the ants, from whose nests their own burrows can scarcely be distinguished. Their economy does not seem to demand the exercise of so much of a true reasoning power and pliable instinct as characterizes those bees, such as the Honey and Humble-bee, which possess a high architectural skill. Moreover they are not social; they have no part in rearing and caring for their young, a fact that lends so much interest to the history of the Hive and Humble-bee. In this respect they are far below the wasps, or *Vespidæ*, a family belonging next below in the system of Nature.

A glance at Mr. Emerton's admirable drawing (Fig. 1) of a burrow of *Andrena vicina* Smith, reveals the economy of one of our most common forms. Quite early in spring, when the sun and vernal breezes have dried up the soil, and the fields exchange their rusty hues for the rich green verdure of May, our Andrena, tired of its idle life among the blossoms of the willow, the wild cherry, and garden flowers, suddenly becomes remarkably industrious, and wields its spade-like jaws and busy feet with a strange and unwonted energy. Choosing some sunny, warm, grassy bank (these nests were observed in the "great pasture" of Salem), not always with a southern exposure however, the female sinks her deep well through

the sod from six inches to a foot into the sandy soil beneath. She goes to work literally tooth and nail. Reasoning from observations made on several species of wasps, and also from studying the structure of her jaws and legs, it is evident that she digs in and loosens the soil with her powerful jaws, and then throws out the dirt with her legs. She uses her forelegs like hands, to pass the load of dirt to her hind legs, and then runs backward out of her hole to dump it down behind her. Mr. Emerton tells me that he never saw a bee in the act of digging but once, and then she left off after a few strokes. He also says, "they are harmless and inoffensive. On several occasions I have laid on the grass near their holes for hours, but not one attempted to sting me; and when taken between the fingers, they make but feeble resistance."

Fig. 1.



Nest (natural size) of *Andrena vicina*, showing the main burrow, and the cells leading from it; the oldest cell containing the pupa (*a*) is situated nearest the surface, while those containing the larva (*b*) lie between the pupa and the cell (*e*) containing the pollen mass and egg resting upon it. The most recent cell (*f*) is the deepest down, and contains a freshly deposited pollen mass. At *c* is the beginning of a cell; *g*, level of the ground.

To enter somewhat into detail, we gather from the observations of Mr. Emerton (who has carefully watched the habits of these bees through several seasons) the following account of the economy of *An-*

drena vicina. On the 4th of May the bees were seen digging their holes, most of which were already two inches deep, and one six inches. The mounds of earth were so small as to be hardly noticed. At this time an Oil-beetle (*Meloë*) was seen prowling about the holes. The presence of this dire foe of Andrena at this time, it will be seen in a succeeding paper on the enemies of the bees, is quite significant. By the fifteenth of May hundreds of Andrena holes were found in various parts of the pasture, and at one place, in a previous season, there were about two hundred found placed within a small area. One cell was dug up, but it contained no pollen. Four days later, several Andrenas were noticed resting from their toil at the opening of their burrows. On the twenty-eighth of May, in unearthing six holes, eight cells were found to contain pollen, and in two of them a small larva. The pellets of pollen are about the size of a pea. They are hard and round at first, before the young has hatched, but as the larva grows the mass becomes softer and more pasty, so that the larva buries its head in the mass, and greedily sucks it in. When is the pollen gathered by the bee and kneeded into the pellet-like mass? On June 4th, a cell was opened in which was a bee busily engaged preparing the pollen, which was loosely and irregularly piled up, while there was a larva in an adjoining cell nearly half an inch long. It would seem, then, that the bee comes in from the fields laden with her stores of pollen, which she elaborates into bee-bread within her cell.

When the bee returns to her cell she does not directly fly towards the entrance, since, as was noticed in a particular instance, she flew about for a long time in all directions without any apparent aim, until she finally settled near the hole, and walked into her subterranean

retreat. On a rainy day, May 24th, our friend visited the colony, but found no bees flying about the holes. The little hillocks had been beaten down by the pitiless rain-drops, and all traces of their industry effaced. On digging down, several bees were found, indicating that on rainy days they seek the shelter of their holes, and do not take refuge under leaves of the plants they frequent.

On the 29th of June six full-grown larvæ were exhumed, and one about half grown. On the 20th of July the colony seemed well organized, as, on laying open a burrow at the depth of six inches, he began to find cells. The upper ones, to the number of a dozen, were deserted and filled with earth and grass roots, and had evidently been built and used during the previous year. Below these were eight cells placed around the main vertical gallery, reaching down to the depth of thirteen inches, and all containing nearly full-grown larvæ of the bees, or else those of some parasitic bee (*Nomada*) which had devoured the food prepared for the young Andrena.

About the first of August the larva transforms to a pupa or chrysalis; as at this time two pupæ were found in cells a foot beneath the surface. As shown in the cut, those cells situated lowest down seem to be the last to have been made, while the eggs laid in the highest are the first to hatch, and the larvæ disclosed from them the first to change to pupæ. Four days later the pupæ of *Nomada*, or Cuckoo-bees, were found in the cells. No Andrenas were seen flying about at this time.

On the 24th of August, to be still very circumstantial in our narrative, though at the risk of being tedious, three burrows were unearthed, and in them three fully formed bees were found, nearly ready to leave their cells, and in addition several pupæ. In some other cells

there were three of the parasitic Nomada also nearly ready to come out, which seemed to be identical with some bees noticed playing very innocently about the holes early in the summer.

On the last day of August, very few of the holes were open. A number of Oil-beetles (*Meloë*) were strolling suspiciously about in the neighborhood, and some little black Ichneumon flies were seen running about among the holes.

During midsummer the holes were found closed night and day by clods of earth.

The burrow is sunken perpendicularly, with short passages leading to the cells, which are slightly inclined downwards and outwards from the main gallery. The walls of the gallery are rough, but the cells are lined with a mucous-like secretion, which, on hardening, looks like the glazing of earthen-ware. This glazing is quite hard, and breaks up into angular pieces. It is evidently the work of the bee herself, and is not secreted and laid on by the larva. The diameter of the interior of the cell is about one-quarter of an inch, contracting a little at the mouth. When the cell is taken out, the dirt adheres for a line in thickness, so that it is of the size and form of an acorn.

The larva of Andrena (Fig. 2) is soft and fleshy, like that of the Honey-bee. Its body is flattened, bulging out prominently at the sides, and tapering more rapidly than usual towards each end of the body. Seen sideways, the thoracic rings are quite prominent, giving a serrated outline to the body. The skin is very thin, so that along the back the heart or dorsal vessel may be distinctly seen, pulsating about sixty times a minute.

Our cut (Fig. 1) also represents the pupa, or chrys-

alis, as seen lying in its cell. The limbs are folded close to the body in the most compact way possible. On the head of the semi-pupa, *i. e.* a transition state between the larva and pupa, there are two prominent tubercles situated behind the simple eyes, or ocelli; these are deciduous organs, apparently aiding the insect in moving about its cell. They disappear in the mature pupa.

Fig. 2.

To those accustomed to rearing butterflies, and seeing the chrysalis at once assuming its perfected shape, after the caterpillar skin is thrown off, it may seem strange to hear one speak of a "half-pupa," and of stages intermediate between the larva and pupa. But as we have before stated on page 429, the external changes of form, though rapidly passed through, consisting apparently of a mere sloughing off of the outer skin, are yet preceded by slow and very gradual alterations of tissues, resulting from the growth of cells.* An inner layer of the larva-skin separates from the outer, and, by changes in the form of the muscles, is drawn into different positions, such as is assumed by the pupa, which thus lies concealed beneath the larva-skin. But a slight alteration is made in the general form of the larva, consisting mostly of an enlargement of the thoracic segments, which is often overlooked, even by the special student, though of great

Fig. 3.

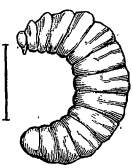


Fig. 4.

Fig. 2. Larva of *Andrena vicina* Smith.
Fig. 3. Pupa of *Halictus parallelus* Say seen from beneath.
Fig. 4. Larva of *H. parallelus*.

*On page 429, line 5, we say, "the changes though rapid are gradual." It should read, the changes (*i. e.* actual moultings) are rapid, though the steps that lead to them are gradual.

interest to the philosophic naturalist. Special attention has been drawn to this "semi-pupa" state by Ratzburg, in his "Development of Footless Hymenopterous Larvæ," and by Professor Agassiz, in his "Classification of Insects from Embryological Data" (Smithsonian Contributions), wherein he refers to the changes of the caterpillar of a butterfly (*Eudamus Tityrus*), just before assuming the chrysalis or pupa state.

From Mr. Emerton's observations we should judge, that the pupa state lasted from three to four weeks, as the larvæ began to transform the first of August, and appeared during the last week of the same month as perfect bees.

Andrena vicina is seen as late as the first week in September, and again early in April, about the flowers of the willow. It is one of the largest of its genus and a common species.

Having, in a very fragmentary way, sketched the life-history of our Andrena, and had some glimpses of its subterranean life, let us now compare with it another genus of solitary bees (*Halictus*) quite closely allied in all respects, though a little lower in the scale.

The *Halictus parallelus* Say, excavates cells almost exactly like those of Andrena; but since the bee is smaller, the holes are smaller, though as deep. Mr. Emerton found one nest in a path a foot in depth. Another nest, discovered September 9th, was about six inches deep. The cells are in form like those of Andrena, and like them are glazed within. The egg is rather slenderer and much curved; in form it is long, cylindrical, obtuse at one end, and much smaller at the other. The larva (Fig. 4) is longer and slenderer, being quite different from the rather broad and flattened larva of Andrena. The body is

rather thick behind, but in front tapers slowly towards the head, which is of moderate size. Its body is somewhat tuberculated, the tubercle aiding the grub in moving about its cell. Its length is nearly one-half (.40) of an inch. On the pupa are four quite distinct conical tubercles forming a transverse line just in front of the ocelli; and there are also two larger, longer tubercles on the outer side of each of which an ocellus is situated. Figure 3 represents the pupa seen from beneath.

Search was made on July 16th, when the ground was hard as stone for six inches in depth, below which the soil was soft and fine, and over twenty cells were dug out. "The upper cells contained nearly mature pupæ, and the lower ones larvæ of various sizes, the smallest being hardly distinguishable by the naked eye. Each of these small larvæ was in a cell by itself, and situated upon a lump of pollen, which was the size and shape of a pea, and was found to lessen in size as the larva grew larger. These young were probably the offspring of several females, as four mature bees were found in the hole." The larva of an English species hatches in ten days after the eggs are laid.

Another brood of bees appeared the middle of September, as on the ninth of that month (1864) Mr. Emerton found several holes of the same species of bee made in a hard gravel road near the turnpike. When opened, they were found to contain several bees with their young. September 2d, of this year, the same kind of bee was found in holes, and just ready to leave the cell. It is probable that these bees winter over.

We have incidentally noticed the presence in the nests of Andrena and Halictus of a stranger bee, clad in gay, fantastic hues, which lives a parasitic life on its hosts.

This parasitism does not go far enough to cause the death of the host, since we find the young of the parasitic *Nomada*, or Cuckoo-bee, in cells containing its young.

Mr. F. Smith, in his "Catalogue of British Bees," says of this genus: "No one appears to know anything beyond the mere fact of their entering the burrows of *Andrenidæ* and *Apidæ*, except that they are found in the cells of the working bees in their perfect condition: it is most probable that they deposit their eggs on the provision laid up by the working bee, that they close up the cell, and that the working bee, finding an egg deposited, commences a fresh cell for her own progeny."

He has, however, found two specimens of *Nomada sexfasciata* in the cells of *Eucera longicornis*, the Long-horned bee. He also states, that while some species are constant in their attacks on certain Halicti and Andrenæ, others attack different species of these genera indiscriminately. In like manner another Cuckoo-bee (*Cœlioxys*) is parasitic on *Megachile* and *Saropoda; Stelis* is a parasite on *Osmia*, the Mason-bee; and *Melecta* infests the cells of *Anthophora*.

The observations of Mr. Emerton enable us still farther to clear up the history of this obscure visitor. He found both the larva and pupa, as well as the perfect bee, in the cells of both genera; so that either both kinds of bee, when hatched from eggs laid in the same cell, feed on the same pollen mass, which therefore barely suffices for the nourishment of both; or the hostess, discovering the strange egg laid, cuckoo-like, in her own nest, has the forethought to deposit another ball of pollen to secure the safety of her young.

Is such an act the operation of a blind instinct? Does it not rather ally our little bee with those higher animals

which undoubtedly possess a reasoning power? Its *instinct* teaches it to build cells, and prepare its pollen mass, and lay an egg thereon. Its *reason* enables it, in such an instance as this, when the life of the brood is threatened, to guard against any such danger by means to which it does not habitually resort. This instance is paralleled by the case of our common Summer Yellow-bird, which, on finding an egg of the Cow-bunting in its nest, often builds a new nest above it, to the certain destruction of the unwelcome egg in the nest beneath.

In the structure of the bee, and in all its stages of growth, our parasite seems lower in the zoölogical scale than its host. It is structurally a degraded form of Working-bee, and its position socially is unenviable. It is lazy, not having the provident habits of the Working-bees; it aids not in the least, so far as we know, the cross-fertilization of plants,—one great office in the economy of nature which most bees perform,—since it is not a pollen-gatherer, but on the contrary is seemingly a drag and hinderance to the course of nature. But yet nature kindly, and as if by a special interposition, for which the Developmentists will find it difficult to account, provides for its maintenance, and the humble naturalist can only exclaim, "God is great, and His ways mysterious," and go on his way studying and collecting facts, leaving to his successors the more difficult task, but greater joy of discovering the cause and reason of things that are but a puzzle to the philosophers of this day.

The larva of *Nomada* may be known from those of its host, by its slenderer body and smaller head, while the body is smoother and more cylindrical. Both sexes of *Nomada imbricata* and *N. pulchella* of Smith were found by Mr. Emerton, the former in both the Andrena and

Halictus nests, and both species were found in a single Andrena nest.

The interesting history of the Oil-beetle (*Meloë*) and its wonderful transformations, and of the Stylops and other bee-parasites, cannot now detain us. We hope to lay an account of them before our readers at some future time.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 547.)

THE genus Succinea, of which we have three marked species in New England, is furnished with a thin, translucent, and elastic shell. The soft parts resemble those of Helix, but the creeping disk is quite short and broad, and the tentacles are short and swollen at their bases. The shell is entirely unlike Helix, being ovate-conic, and not rolled in a plane.

SUCCINEA TOTTENIANA. (Fig. 46.) Shell ovate, amber-colored, thin, translucent, shining. Whorls about three, the last very large; spire not prominent, suture distinct. The aperture is three-fourths the length of the shell, and so open that the animal when contracted within the shell is plainly visible. Length of shell from $\frac{5}{8}$ to $\frac{3}{4}$ of an inch. The animal is of a salmon-color, and the shell is sufficiently translucent to reveal the color of the viscera within. This species appears to be confined to New England and the Provinces. It is represented in the Western States by *S. obliqua*, a heavier and larger shell. It occurs in woods and fields. Sometimes found in great numbers in the roadways after a heavy dew.

Fig. 46.